

STUDIES ON STAPHYLOCOCCUS
FOOD POISONING

BY

DOROTHY LILLIAN HUSSEMAN

B.S., University of Illinois, 1928

M.S., University of Illinois, 1929

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
BACTERIOLOGY IN THE GRADUATE SCHOOL
OF THE UNIVERSITY OF ILLINOIS,

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STUDIES ON STAPHYLOCOCCUS FOOD POISONING

One of the most important problems of food sanitation, today, is control of staphylococcus intoxication. While many outbreaks occurred previously, a survey of the literature between 1940 and 1945 revealed at least 533 such food poisoning outbreaks, with a total of more than 21,683 cases. It is a matter of record that only a few cases of this type of illness find their way into printed reports. The purpose of this work has been to study further certain public health aspects of the staphylococcus food poisoning problem. Two approaches to the problem were made. First, it seemed desirable to ascertain the frequency of occurrence and possible enterotoxigenicity of staphylococci in foods which were prepared for service to relatively large groups of people because many outbreaks have been caused in such groups. Staphylococci have often been found in foods which have caused severe gastroenteritis. Whether presence of staphylococci in food necessarily predestines a food poisoning outbreak has not been determined. It seemed of value to make such observations, because if the occurrence of staphylococci always correlated with a food poisoning outbreak, then the establishment of cause and effect was very simple. If, however, presence of staphylococci in foods does not always culminate in a food poisoning epidemic, then perhaps in the past in some cases to these organisms have been ascribed illnesses which they did not cause. Some other organism may have escaped detection. Knowledge of such possibilities would seem to aid materially in food poisoning control.

Therefore, in an endeavor to determine the incidence of staphylococci in the food supply, 160 samples of such ingredients of food preparation as sugar, flour, cornstarch, cocoa, raw, pasteurized and evaporated milk, fresh, dried and frozen eggs, butter, oleomargarine and prepared cream filling mixes were secured. Each sample represented a separate market unit, except in the case of the eggs in which each egg did not represent a dozen or other unit. In addition, 220 samples of prepared foods of types commonly served in public eating places were collected. These were obtained from college cafeterias, a private club, small campus restaurants, drug-store lunch counters, three commercial bakeries and an Army Air Field; at the latter place specimens were secured from the general mess, the officer's mess, the hospital mess, the non-commissioned officer's club, the officer's club, the service club and the post exchange. These prepared foods included samplings

of such items as cream-filled desserts, creamed dishes, meats, sandwich fillings, salads, cheese, soups and salad dressings.

At least 2 platings and often as many as 6 platings were made of each ingredient and of each prepared food. The media used for this purpose were phenol red mannitol agar and bromthymol blue lactose agar (Difco). The plates were picked and from the strains of staphylococci obtained 40 were compared with 28 strains of staphylococci which were known to have been recovered from foods which were incriminated in food poisonings. Reactions of the strains of both groups were determined for the following tests: pigment formation, hemolysis, coagulase formation, fermentation of mannitol with the production of acid, growth on bromthymol blue lactose agar, growth on 7.5 per cent sodium chloride phenol red mannitol agar, and zoning on Stone's medium. A very much more limited number of strains were examined for enterotoxin formation using the Dolman kitten test.

The second part of the investigation attempted to establish thermal death times for staphylococci in cream filling and to correlate such findings with the temperatures attained in accepted cooking procedures for cream filling and cream puff pastry. Thermal death time determinations were also made at a range of temperatures using a phosphate buffer solution as the suspending medium for the staphylococci. Sterile cream filling was prepared and inoculated with approximately 113,000,000 cells of a 24-hour growth of *Staphylococcus aureus* Strain C12069 (Dolman) per milliliter. The multiple tube method for thermal death time determinations was used and observations were made at 55 degrees Centigrade, 65 degrees Centigrade, 75 degrees Centigrade and 85 degrees Centigrade. For the first two temperatures listed, time intervals studied included 4, 5, 6, 7, 8, 10, 12, and 30 minutes. At 75 degrees the time intervals were the same except that the determination at 30 minutes was omitted. At 85 degrees Centigrade time intervals included in the observations were 2, 3, 4, 5, and 6 minutes. For the determinations made on the effect of heat on the same strain of staphylococci, in phosphate buffer solution (approximately 96,000,000 cells per milliliter) the temperatures used were 45 degrees Centigrade, 55 degrees Centigrade, 65 degrees Centigrade and 75 degrees Centigrade. The time intervals were 4, 5, 6, 7, 8, 10, 12 and 30 minutes for the two former temperatures and 4, 5, 6, 7, 8, 10, and 12 minutes for the two latter temperatures.

Cream puffs were prepared by common methods of cooking procedure using ingredients purchased from retail markets. Detailed cooking and baking temperatures were obtained using copper-constan-

tin thermocouples and an automatic 6-point recorder. One hundred twenty-eight platings were made of the cream puff pastry and the same number were made of the cream puff filling, using phenol red mannitol agar and bromthymol blue lactose agar. These plates were examined for the presence of staphylococci.

Of the 160 samples of ingredients examined for the presence of staphylococci, 19 or 11.8 per cent were positive. These positive samples were confined to certain of the cream, the raw milk, the pasteurized milk and the dried egg specimens. Of the prepared food 44 or 20 per cent of the 220 samples examined harbored staphylococci. The samples positive for staphylococci were found to be numerous in the food groups which are most commonly associated with food poisoning outbreaks. Ham products and meats other than ham, cream-filled mixtures, chicken, and sandwich fillings gave relatively high numbers of positive samples. It must be emphasized that these probably were minimum incidence data.

When the 40 strains of staphylococci recovered from food believed not to have caused food poisoning and 28 strains having as their origin foods which had caused food poisoning were compared, there was found to be the greatest divergence in number and degree of pigment formers, number yielding a positive coagulase test and number showing fermentation of mannitol with the formation of acid. For these three characteristics the staphylococci of food poisoning origin showed a higher incidence of positive reactions. The Dolman tests were inconclusive.

Staphylococcus aureus Strain C12069 (Dolman) was found to survive for more than 30 minutes at 55 degrees Centigrade when suspended in cream filling. In this substate at 65 degrees Centigrade, sterility was attained in 8 minutes, at 75 degrees Centigrade the organisms were apparently destroyed in less than 4 minutes of heating, and in less than 3 minutes of heating at 85 degrees Centigrade. When the lag in heat penetration into the cream filling contents of the tube is considered, it is probable that the thermal death time is less than is reported here, for each temperature. In a phosphate buffer solution cells of *Staphylococcus aureus* Strain C12069 (Dolman) remained viable after 30 minutes of heating at 45 degrees Centigrade, were totally destroyed in 8 minutes at 55 degrees Centigrade and did not survive 4 minutes of heating at 65 degrees and 75 degrees Centigrade, respectively. Lag in heating of the contents of the tube must again be considered.

When such temperatures as were attained during the cooking of

cream filling and the precooking and baking of cream puff pastry were correlated with temperatures shown to destroy the organisms by the thermal death determinations, it appeared that at the conclusion of cookery both filling and pastry were sterile in regard to staphylococci, using the strain tested here as an index. This was further verified by the plating of the cream puffs. No staphylococci were recovered from the 256 platings of filling and pastry made on phenol red mannitol agar and bromthymol blue lactose agar.

It would appear then that the problem of staphylococcus food poisoning, at least in regard to cream filling and cream puff pastry, is one of handling after cookery is complete. One is forced to consider the possibility of the human carrier as a potential foci of infection. Poor personal hygiene on the part of cooks, bakers and chefs may enter into the problem also.

It must be recognized that the whole staphylococcus food poisoning problem suffers for want of an accurate means of analysis for the presence of enterotoxin. No animal and no biochemical test yet devised seems to have been wholly successful in detecting the presence of the enterotoxin. The circumstances which lead to formation of enterotoxin by the organism have never been definitely established. Until suitable techniques are developed which will yield information on these points, work on staphylococcus food intoxication is much hampered.

VITA

Dorothy Lillian Husseman was born February 15, 1908 in Peoria, Illinois. She attended the elementary and secondary schools in Roanoke, Illinois, graduating from the latter in 1924. The Bachelor of Science degree was conferred by the University of Illinois in 1928 and the Master of Science degree by the same institution in 1929. During 1929-30 she was employed as research assistant in Home Economics and the next year joined the Faculty of the University of Wisconsin with the rank of instructor. In 1940 she was advanced to the rank of assistant professor in Home Economics at that institution and continued in that capacity until taking leave of absence for graduate study, following which time she will return with the rank of associate professor. During the years 1930-1944 she did graduate work at the University of Wisconsin, intermittently, and also studied for one summer at the Oregon State College.

She is a member of Sigma Xi, Phi Sigma, Omicron Nu, Phi Upsilon Omicron, Sigma Delta Epsilon, Iota Sigma Pi, Society of American Bacteriologists, Institute of Food Technologists, the American Public Health Association, the American Dietetic Association and the American Home Economics Association. During the four years of undergraduate study she held the County Scholarship in Home Economics, during the time of study for the Master's degree she held the College of Agriculture Fellowship and during the year 1945-46, the Ellen H. Richards Fellowship was awarded to her by the American Home Economics Association. She was given Bronze Tablet honors as a college senior.

Her publications include:

The vitamin B and G requirements of lactation. *J. Nutr.* 4, 127-140 (1931).

Vitamin-B and Vitamin-G content of cereals. (Joint Author) *Univ. Ill. Agric. Exper. Sta. Bull.* 369.

The technic of home canning. *J. Wisc. Med. Soc.*, May, 1943.

Series of popular articles on canning—*Hoard's Dairyman*, Spring, 1943.

How to pasteurize milk at home (Joint Author) *Spec. Circ. Univ. Wisc.*, 1944.



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